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高斯混合模型在風機預兆式健康管理上的應用研究
Study on the Application of Gaussian Mixture Model in the Prognostic and Health Management of Wind Turbine

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摘要

本研究提出以高斯混合模型(Gaussian Mixture Model)為核心建立風機預兆式健康診斷與預測的方法，並以信心值作為評估風機健康狀況之指標。此方法包含：採用 DBSCAN 過濾風機原始參數，以高斯混合模型建立風機營運性能模型，再利用迴歸分析預測風機未來營運的健康狀況。

本研究以所建立的診斷方法對台電林口四號風機的資料進行分析，分析結果顯示，此風機在正常運作情況下，信心值約在 0.4 至 0.8 間，但風機營運出現異常狀況時，信心值大多低於 0.4。而 2013 年至 2015 年三年間信心值變化呈現穩定狀態，代表此風機在這三年間健康狀況並 無太大性能衰退。另外透過迴歸分析計算可得，2033 年 8 月 8 日後整體健康狀況信心值會低於 2013 年平均值的兩個標準差以下，表示此風機性能可能在該時間衰退至不健康之狀態。

關鍵詞：風力發電機，高斯混合模型，預兆式健康管理。

Abstract

A prognostic and health management model based on the Gaussian mixture model was proposed to analyze and predict the performance of a wind turbine by using confidence value(CV) as a health index. The proposed method includes preprocessing the raw data of wind turbines by DBCSAN (Density-Based Spatial Clustering of Applications with Noise), building the model of operating performance of wind turbines by GMM (Gaussian Mixture Model), indicating the operating performance by the CV (Confidence Value), and predicting the future CV by regression analysis. The proposed method was applied to analyze the performance data of the Wind Turbine No.4 of the Taipower Company at Linkou District. The analysis showed that the CV is between 0.4 and 0.8 in the normal condition and is smaller than 0.4 in the abnormal condition. The CV of the wind turbine is stable between 2013 and 2015. That is, the performance of this wind turbine was not decaying obviously. Furthermore, by regression analysis, the trend of CV will reduce to 0.66 which is out of 2 standard deviations below the mean of 2013 on August 8, 2033. It means that the wind turbine may be unhealthy at that time.

Keywords: Wind Turbine, Gaussian Mixture Model, Prognostic and Health Management.